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ABSTRACT

The background research on learning styles spans several decades, though much of it is quantitative data obtained using survey methods. Similarly, the research involving twins and their unique genetic condition historically predates the interest and knowledge of learning styles. This study seeks to explore both of these areas with the objective of discovering patterns and emergent themes of benefit to educators, parents, and twins. Data for this study comes from in-depth interviewing, grounded surveys, document collection, and the use of a learning styles instrument. Fifty pairs of twins participated in the study and were selected on several criteria including a minimum of 12 years of traditional school experience, interest or academic pursuit of science or technology related education, and a willingness to be interviewed, take the survey, and complete the other documents. Results indicate that twins exhibit great similarity in motivation for studying science and unique communication patterns. (DDR)

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The Learning Styles of Monozygotic Twins Studying Science

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The background research on learning styles spans several decades, though much of it is quantitative data obtained using survey methods. Similarly, the research involving twins and their unique genetic condition historically predates the interest and knowledge of learning styles by several decades. This study sought to explore both of these areas with the objective of discovering patterns and emergent themes of benefit to educators, parents, and twins.

Some Prominent and Varied Research on Twins

- Bouchard, Lykken, McGue, et al (1990)
  - MZ twins reared apart / together, personality & IQ
- Lykken (1982) "emergenic" interaction
- Thompson, Dotterman, Plomin (1991)
  - Cognitive ability & scholastic achievement
- McClearn, Johansson, Berg, et al (1997)
  - 80+ year old twins and genetics over time
- Devlin, Daniels, & Roeder (1997)
  Meta-analysis, maternal womb environments

Many of the previous twin research studies have appeared preoccupied with discovering the similarities and differences of twin psychological, physiological (especially genetic links to diseases and the aging process), and cognitive measures (especially intelligence quotient or IQ). Some have struggled inconclusively over the importance of genetic verses environmental factors in determining twin behavior and ability. And while many of these studies were important in helping researchers decide to

focus and hone their research efforts, many did not yield information that could be applicable to how individuals or twins approach learning.

This study is, in many regards, a unique opportunity to explore the details of how monozygotic or identical twins learn new or difficult information. For while much research involving twins has occurred in the context of psychological, physiological, and social dimensions, very little research has focused on how they learn. Studies that have attempted to explore this area have often been preoccupied with general cognitive ability and Intelligence Quotient (I.Q.), or other external manifestations of one's intellectual ability. Many studies have also relied heavily upon the quantitative methods and numerical data. This study is different from previous studies largely because it sought to uncover the layers of meaning that determine how individuals perceive and process information. To accomplish this, qualitative methods of data collection and analysis were employed.

In addition to the use of naturalistic methods, specifically in-depth interviewing, this study attempted to avoid some of the assertions and pitfalls emphasized in other studies. It is necessary to briefly describe some of them here for historical clarification. One of the most prominent theories or controversies involving twin research is that of the debate between influences of one's heredity (genetics) and one's environment (nurture). Some studies have gone so far as to estimate the influence imposed by each of these factors. Currently, many researchers avoid such a reduction for many good reasons. First it is impossible to separate the influences of either of these factors that are constantly and simultaneously operating since one's conception. Secondly, even if one

could accurately calculate the influences of each, it would not necessarily contribute to practical applications or deeper understandings.

Methods Employed

This study involved the collection and review of data gathered from in-depth interviewing, grounded surveys, document collection, and the use of a learning styles instrument called the Dunn, Dunn & Price Productivity Environmental Preference Survey (PEPS). The selection of qualitative methods were used for the following reasons:

- They proved most effective in three previous pilot studies involving twins and their learning styles.
- They were congruent with the objectives of exploring the depth over breadth of twins and how they learn.
- They were consistent with the strengths of data collection and data analysis of the researchers involved, having been field tested.
- The PEPS instrument was selected for its reliable and rich research history, as well as, its comprehensiveness.

Aspects of Learning Styles Investigated

The choice to use the Dunn, Dunn & Price instrument over others available was an important one. For while many theories and models of learning style (LS) exist, this one, often referred to as the Dunn & Dunn LS model, or more simply the Dunn Model, is the most comprehensive and well researched. As of 1996, at least 300 journal articles and research studies had been conducted using the Dunn LS model, many substantiating its reliability and validity.

The comprehensiveness of the Dunn model is evident in its coverage of the following categories, often referred to as "stimuli," and the specific components in each stimuli, often referred to as "elements." It is also important to note that this model has been developed and revised in a span of more than thirty years of research, and is not merely theoretical.

What are learning styles (LS) ?

They are the unique ways individuals perceive (initially "take in") and process ("make sense of") information when learning something new or difficult. Although there are many LS theories, one in particular, the Dunn LS model, is the most comprehensive and thoroughly researched.

Why the Dunn Model of Learning Styles was selected for this study.

The Dunn learning style model includes five major categories called Stimuli that influence how one learns. These five are: Environmental, Physiological, Psychological, Emotional, and Sociological (Specific elements in each of these five stimuli are listed in the table that follows). It is the most practical and most reliable of all LS models. Researchers, teachers, university professors, parents, and students have been able to contribute to and utilize the results of the Dunn research.

What are the specifics of the Dunn LS model?

The table that follows highlights the five categories, or stimuli, of the Dunn LS model. Following each is a listing of the elements in those stimuli. Notice the kinds and various elements that can be extremely important factors in how individuals concentrate

and process information. Such elements and their relevance to learning new or difficult information have been documented in hundreds of studies over the last three decades.

Includes tolerance/preference for or against:
Environmental: sound, light, temperature, and room design*
Physiological: perceptual (auditory, visual, tactual, or kinesthetic), intake of food/drink when studying, time of day, mobility
Psychological: global or analytic characteristics, hemispheric preferences
Emotional: motivation, persistence, and responsibility structuring of tasks
Sociological: working by: one's self, in pairs, with peers, in teams, with adults/experienced persons, or in varied groups

Selection of participants

Initially a twin data base of no less than 50 pairs of twins was assembled for this study. These were male and female pairs from across the United States and Canada, many contacted via twin organizations, twin conventions or festivals, internet home pages of parent or twin organizations, and via advertisements and communications sent to schools and teachers. Participants in this study were selected based on the following criteria:

- Having completed a minimum of 12 years of traditional school experience
- Interest or academic pursuit of science or technology related education
- Committed to being interviewed a minimum of three times and agreeing to complete the PEPS, as well as, other relevant documents or surveys

Three pairs have contributed to this study so far, and much of the data has begun to be analyzed by the primary investigator. As with many qualitative studies, the data analysis involves a lengthily process whereby it is scrutinized and checked (Triangulated) using other data sources and follow-up reviews. Included in this analysis are member checks that ask participants to review and help bring clearer understanding to data. It is important to emphasize that the conclusions reached thus far are based on data that has been analyzed to date, and is not intended to be extrapolated or applied to all pairs of identical twins. As with many post positivist research projects, the aim is not to develop a theory or model that can be generalized to the whole population.

Results of Data Analysis and Emergent Themes

Several themes have begun to surface as the volume of data was read, reread, and eventually dissected, sorted, checked, and assessed. Many of the findings proved to be most valuable in the content revealed in the personal vignettes and authentic experiences of the participants. For such details yield insight into the unique ways individuals perceive and process new and difficult information, besides adding to our understanding of the particulars of the elements that constitute one's learning style.

The following table summarizes some of the elements within each stimuli category and how the findings of one identical twin's style relate to the other twin's. Since this study is largely exploratory, the table's value lay principally in its use as a guidepost for further study and description. Elements in bold type represent those similarities that were emphasized continually in analyzing data sources of both twins.

The display of information is for the first pair of twins having completed all stages of the data gathering process. It is not intended to be all inclusive of monozygotic twins, nor is it considered to be the final analytic results of this study. Further analysis is ongoing will continue as all areas and themes receive greater attention.

Stimuli and Elements of Dunn LS Model with Positive Correlation

Category	Elements:	Comments:
Environmental	**Sound**	**Quiet**, especially when beginning to study
	Temperature	Warm
Emotional	**Motivation**	**Learning & discovery**
	Persistence	**Tasks / others**
	Responsibility	**Personal & Research Reputation**
	Structure	**Unstructured Preference**
Social:	**Self**	**Solitary Preference, at least initially**
Physiological:	**Perceptual**	**Visual & Tactile Strengths**
	Intake	None/Studying
Psychological:	**Global Processors**	**No Extremes**
	Impulsive	Prefer to begin immediately on tasks / delays

Perhaps even more intriguing than the information contained in the previous table are the vignettes and experiences reported by those interviewed. The following themes

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began to emerge from the interaction of participants and the researcher, and thus constitute some of the most valuable data of thick description.

Four of the themes that emerged were:

- Similar motivations for studying science and deciding to pursue science or technology related professions;
- Similar responses and agreement on the benefits of being a twin relating to their learning experiences;
- Unique communication patterns and efficiency of twin communication;
- Twin learning experiences of science, both in formal and informal settings, were similar.

The data of twin pairs studied have shown similar reasons for their choice of science or technology careers. Both the first and second pairs of twins report similar motivations. The first pair reported a desire to know about the world, a sense of curiosity that was traced back to their experiences in the Boy Scouts of America. They also reported the motivational influences that several excellent science teachers and their "knowledgeable and patient" scoutmaster had upon their decision to study science. Although one chose to study pre-medicine as an undergraduate and is now is in medical school, and his brother chose to study chemistry and is now working on his Ph.D. degree at Stanford; both were highly motivated by science instructors who were intellectually stimulating and very approachable. In the second pair of twins, the motivation to enroll in a hospital nursing program to become registered nurses was largely due to their interest

in a challenging career that would be directly involved in helping people. The career opportunities of nursing and the possible opportunities to work in various aspects of critical and emergency care also motivated them. They too, reported being accustomed to the hospital environment from their earliest years in grade school, and both liked learning about the human body in school science classes.

The twins also agreed that being a twin has been beneficial to their learning. They stated the benefits of being recognized by teachers and professors in their science classes. Such recognition was perceived as an opportunity to get to know instructors earlier than other students and as contributing to name recognition.

Another common theme among the pairs of twins was that of each twin reporting unique communication patterns with their sibling twin. There communication with each other was commonly described as "efficient communication," whereby they understood each other more easily and quickly than with others. This feature seemed very intriguing to the friends of the twins, but not so unusual to the twins themselves. And although the twins had efficient communication between themselves, they did not necessarily use it to study together or for learning situations.

The fourth theme that emerged was that of each twin pair reporting similar experiences and particular elements comprising their individual learning styles, while each also having unique elements. Thus, regardless of the stress previous research studies have placed upon the similarities between twins, they also should be recognized as individuals with unique learning styles.

Discussion & Need for Future Research

As one evaluates and interprets the findings, keep in mind that additional research remains to be done in order to further illuminate the unique ways in which individuals, whether twins or singletons, perceive and process new and difficult information. Specific elements of the pairs of twins in this study are not intended to be indicative of all pairs of twins, nor is there any indication that specific elements will be consistently the same for all pairs of identical twins.

Specific elements of learning style need to be investigated using additional qualitative methods in future twin studies. The themes of the unique communication patterns between twins and the part recognition as twins learn should also be investigated separately. Such studies could contribute to a deeper understanding of the ways educators enable individuals and twins to use their learning styles.

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